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SURFACE DRAINAGE Of FLATLANDS

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Some method of surface drainage is required for farming flatlands, especially on soils of low permeability and where rainfall is high and intense. As the term "surface drainage" implies, the excess water is removed in an orderly manner by overland flow.

Ponded water on the land surface after heavy rains indicates a field with depressions and barriers that impede surface drainage and impair crop production. The uneven surface can result from many different causes. Most flat alluvial lands have marks of floodflows—sloughs, depressions, and irregular surfaces—because of unequal distribution of water-transported materials. Failure to smooth the fields after tillage to remove the marks made by farm implements is another reason for this condition. In many cases, inadequate disposition of spoil banks from ditch excavation of field outlet drains leaves barriers that cause ponding.

Research studies in Lousiana show that smooth fields produced 4.59 tons of sugarcane per acre more than land that had 53 percent of its surface ponded 2 inches or more.

Surface drainage is obtained by a system of ditches, field drains, and water furrows. The field drains collect excess water from the land surface or the crop rows and remove it to the lateral, or collection, ditches. Water is then channeled into the main ditches and on into natural or artificial watercourses. Land forming used in the West to assist in applying irrigation water was incorporated in the 1950's through research and development to assist in channeling excess water into the field drains and ditches. Two main systems of field drains and land forming—the cut crowning system and the precision land forming system—have been developed and used in the Mississippi River Valley and adopted in many other States in the humid region and some foreign countries.

The cut crowning system is used for the production of sugarcane, vegetable crops, and pasture. The field is divided into cuts

(areas to be worked) approximately 1,000 feet long and 120 to 240 feet wide (fig. 1). The cuts run parallel with the slope of the field and have a lateral ditch on each side and headland at each end. Cross-furrow drains (quarter drains) are cut through the rows, which are parallel with the lateral ditches. These drains transmit the water from the row middles to the lateral ditches.

FIGURE 1.—Field layout of cut crowning system.

CUT CROWNING SYSTEM

The cuts are formed and smoothed with a crown (not less than 0.3 ft. per 100 ft. side slope) similar to a highway, to facilitate the removal of excess water. Where there is adequate sidefall to the field, the cuts are formed in a plane, sloping from ditch to ditch. Bulldozers are the most efficient equipment for crowning cuts because the earthmoving distance is short. Since the cuts are narrow and the earthmoving distance is short, an experienced operator, with a few indicator points, usually can form the crowns

by eye. Only a few differential levels are required to establish these points.

Previous operations may have caused pockets to be formed where tillage implements entered the land and mounds on the headland where the implements were raised. The first step is to move the earth deposited on the headlands into the depressions made where the implements entered the ground. The earth along the ditches then is moved toward the center of the cut to form the crown (fig. 2). After the cuts are formed, they are smoothed with a landleveler or grader (fig. 3). Crowning also can be done with a motor grader, but not so efficiently as with the bulldozer and land leveler combination (fig. 4).

Crowning costs approximately $45 per acre (1965) in the sugarcane area of Louisiana, usually compensated by the increased crop yield obtained the first season (5.81 standard tons of cane).

A modification of the cut crowning system is used for pasturelands. The land is formed into beds, or corrugations, that follow the slope of the field. Usually the beds are 60 feet wide. Each bed has a flat-sloped ditch (6:1) on each side which blends into the bed, or corrugation, for easier mowing. A motor grader is used for cutting the ditches and casting the earth to the center to form the beds. Where the topography is undulating, the motor grader is used as a bulldozer to move the earth into depressions. Because most of the smoothing is done during the forming operations, very little is required afterward. Costs (1965) for this type of work range from $15 to $60 per acre.

FIGURE 2.—Forming the crown of cuts with a bulldozer.

FIGURE 3.—Smoothing cut with land leveler after crown has been formed with bulldozer.

FIGURE 4.—Forming the crowns of cuts with a motor grader.

PRECISION LAND FORMING SYSTEM

The precision land forming system, first used in the production of cotton, is now used in the production of all crops except rice and pasture. The field is divided into larger units than for cut crowning. The topography and soil texture determine the size of the units, which range from 800 to 1,000 feet wide, with a lateral ditch on each side of the unit. Each unit is precision formed for a smooth surface to assist in removing excess water to a flat-sloped field drain at the lower end of the unit. This field drain is located where there is a major change in slope or soil type. Thus, the length of the units vary with local conditions and no definite criterion is necessary because research in Louisiana shows that row length is not significant. The field drain transmits the water to a lateral ditch on each side (figs. 5 and 6).

The first operation in land forming is to dispose of any crop residue and native vegetation by shredding, disking, or burning. Plowing down material is not recommended because earthmoving equipment works better on firm ground. If the ground is not firm, it is difficult to obtain accurate level information when making the topographic survey to determine the grade at which the field is to be formed and the quantity of earth to be moved.

Because most landowners lack surveying experience, they will require technical assistance to plan and execute their land forming.

The topographic survey is made on grids of 100 feet, with the level reading taken at each grid corner. Grid stakes are left in place for marking the cuts and fills after the computations are made.

Grades within the range of 0.1 to 0.3 foot per 100 feet are recommended. Grades less than 0.1 foot per 100 feet are difficult to construct and maintain. If the grades are above 0.3 foot per 100 feet, erosion may occur on clean-cultivated land. Each unit should have a cross slope of at least 0.05 foot per 100 feet.

The stakes at each grid corner are marked so that the operator can determine the amount of cut or fill, which the operator uses as a reference in forming the land. The field is then formed with tractors and carrier-type scrapers (fig. 7). After the field is formed, it is smoothed with a land leveler to correct any small discrepancies in grade (fig. 8).

The field drains (fig. 9) are cut with either a scraper or a motor grader. Because they are crossed with farm machinery (fig. 10), they should have a minimum side slope of 10 horizontal to 1 vertical on the headland side. They should range in depth from 0.5 to 1.0 foot and should be 0.2 foot below the row middles. They are constructed with the sidefall of the field.

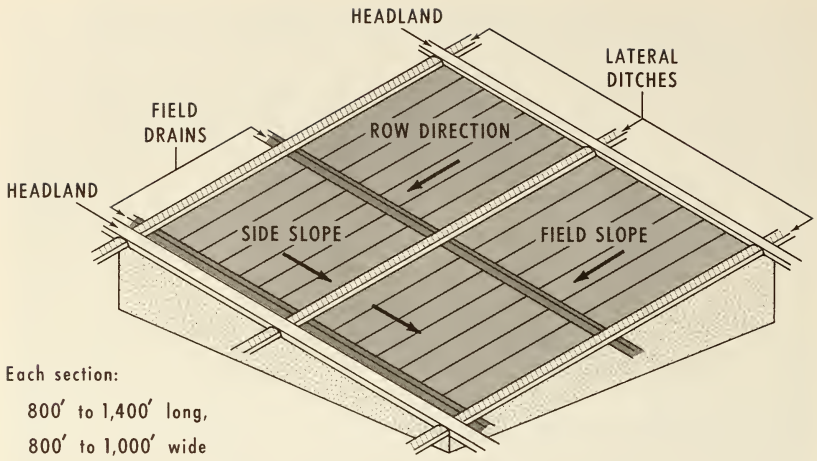

FIGURE 5.—Unit layout of precision land forming system.

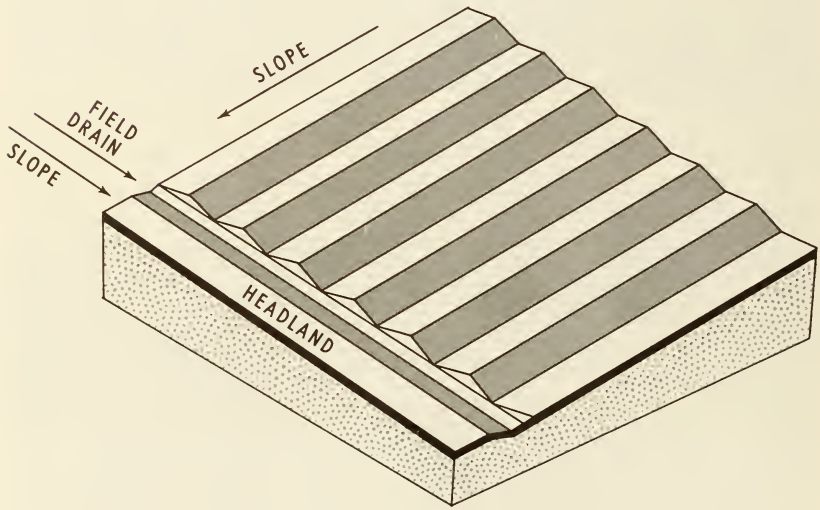

FIGURE 6.—Diagram of corner of unit of precision-formed land.

The lateral ditches should be deeper than the field drains, as they are designed to carry water from the field drains. Their side slopes should be no steeper than 3 horizontal to 1 vertical where

FIGURE 7.—Rough grading precision-formed land.

vegetation is controlled by mowing. Vegetation is controlled on steeper slopes by using herbicides or ditchbank burners.

The cost of this system depends on the amount and distance of earthmoving that is necessary; it ranges from $65 to $100 per acre in the Mississippi River Valley (1965).

FIGURE 8.—Finishing with land leveler after scraper operations on precision-formed land.

BENEFITS FROM LAND FORMING SYSTEMS

Benefits to be gained from land forming depend on field conditions before the drainage system is installed. In many instances, a drainage system means the difference between producing a good crop and having a crop failure. Better drainage always improves crop yields.

In addition to increasing crop yields, there are other benefits from formed land. Farm equipment works more efficiently because of a more uniform moisture content. Tractors are not impeded by wet spots. The smooth surface of formed land assists in accurate seed placement and herbicide application, which results in better crop stands and more efficient weed control. Harvesters are not diverted from their line of travel by depressions and do a much better job of harvesting.

Limited data are available on the increased benefits of formed pastures; however, some drainage is usually a prerequisite to pasture establishment. Landowners report an increased carrying capacity and a decreased incidence of cattle bogging in formed pastures.

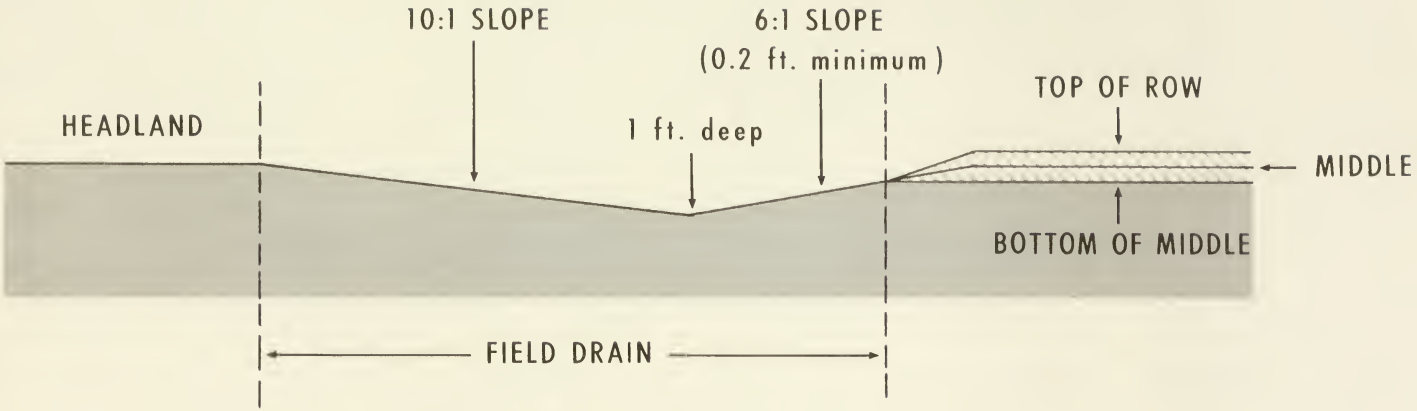

FIGURE 9.—Recommended field drain cross section.

FIGURE 10.—Crossing field drains with farm implements.

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